

UNIT 4

EVOLUTION

- ❖ Evolution is a change in genetic composition of a population over successive generations, which may be caused by meiosis, hybridization, natural selection or mutation. This leads to a sequence of events by which the population diverges from other populations of the same species and may lead to the origin of a new species.

THEORIES OF ORIGIN OF LIFE

- ❖ The origin of life refers to the emergence of self-replicating, heritable, and evolvable organisms. This is a complex and often controversial subject in science. Historically, two prominent perspectives on the origin of life were intelligent design and creationism, which offered alternative explanations. However, with the advent of modern scientific discoveries, particularly the Big Bang theory, new ideas emerged about the origins of life and the development of complex organisms.
- ❖ According to the Big Bang theory of the universe's origin, it is hypothesized that the universe began as a simple state and gradually evolved into its current form over billions of years. This concept has also influenced theories on the origin of life, suggesting that, just as the universe evolved from simple elements, complex life forms on Earth, including humans, arose over time from simpler organisms, such as bacteria.
- ❖ Theory of evolution describes how the various form of life on earth (including human) emerged and develop.

1. Special creationism

2. Spontaneous generation

3. Eternity of life

4. Cosmozoan theory

5. Biochemical origin

Special Creationism

- ❖ SAYS that the formation of life on Earth was the result of supernatural or divine forces. This view suggests that a supreme being, or deity, directly created life. Special creationism is often tied to religious beliefs, with various interpretations across different cultures and religions.
- ❖ However, acceptance of **evolutionary theory** is rooted in scientific thinking, which contrasts fundamentally with special creationism. The two perspectives are based on different worldviews, and the gap between them is unlikely to be resolved, as they operate within distinct frameworks of evidence and belief.
- ❖ There are many different versions of special creation, linked with different religions

2. Spontaneous generation

- ❖ in which life is believed to arise from non-living matter; this was finally disproved by experiments of Francisco Redi and Louis Pasteur.
- ❖ rotting meat turned into flies wine produce bacteria as went sour.
- ❖ it was once believed that life could come from non-living things such as :-
 - Mice from corn
 - Flies from bovine manure
 - Maggots from rotting meat
 - Fish from mud of previously dry lake

Francisco Redi(1668)

- ❖ Disproved spontaneous generation by an experiment
- ❖ He placed fresh meat in jars . One jar was left open and the others were covered by a cloth . Days later ,the opened jar contained maggots whereas the covered jars contained no maggot ,but maggots appeared on the exterior surface of the cloth
- ❖ Redi successfully demonstrated that the maggots came from fly eggs

3. Eternity of life(steady-state theory)-

- ❖ in which life is believed to have existed forever and will to exist forever and so no origin required. “The universe is unchanging.”
- ❖ Suggest that “There is no beginning and no end to life.”

4. Cosmozan theory

- ❖ in which either life forms of the organic molecules need for origin of life believed to have been brought to earth by meteorites and comet from other planet.
- ❖ proposed by Richer and supported by Arrhenium
- ❖ According to this theory, life has reached this planet Earth from other cosmological structures, such as meteorites, in the form of highly resistant spore
- ❖ claims that life on Earth originally came from elsewhere in the Universe (possibly from another planet)
- ❖ strongly linked to the ‘eternity of life’ theory

5 biochemical theory(abiogenesis)

- ❖ suggests that life on Earth originated as a result of a number of biochemical reactions producing organic molecules which associated to form cells
- ❖ life evolved from non-biological molecules which reacted together and eventually formed pre-cells
- ❖ Two biologists (Aleksandr Oparin and John Haldane) proposed that ;
- ❖ Common gases in the early earth atmosphere combined to form organic chemicals by the energy of ultra violet light
- ❖ organic molecules form more complex molecules
- ❖ The complex molecules acquired some characteristics of living organisms
- ❖ later Stanley Miller approved the oparin-Haldane model by spark-discharge experiment
- ❖ The passed electric sparks repeatedly through a mixture of gases(CH₄,NH₃,H₂O ,H₂).

- ❖ he analysed the liquid in the water trap and found it contained a simple organic molecules such as (HCN)
- ❖ by leaving the equipment for longer periods of time, more complex organic molecules such as (amino acids ,pentose sugars ,hexose sugars) were formed

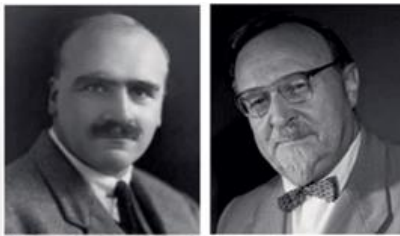
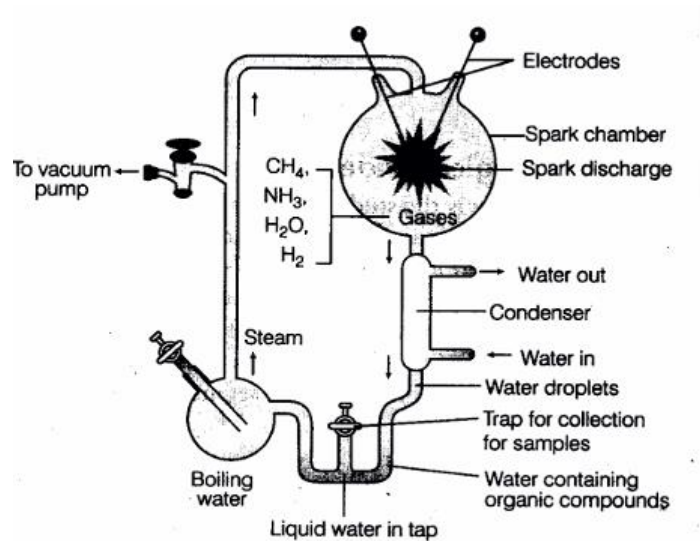


Figure 4.4 J B S Haldane and A I Oparin



Theories of evolution

Lamarckism

claimed that organisms passed on to subsequent generations traits acquired during their lifetime

The two parts of his theory are:

- Use and disuse, and
- Inheritance of acquired traits.

a. Use and disuse

- ❖ Lamarck suggests that by continually using a structure that structure will become enlarged or more developed.
- ❖ Any structure that is not used or is little used will become reduced in size or less developed.

examples

o penguins wings would have become smaller than those of other birds because penguins do not use them to fly.

However, Lamarck could not explain how these might happen.

b. Inheritance of acquired traits

- ❖ Lamarck believed that Traits changed or acquired during an individual's lifetime could be passed on to its offspring.
- ❖ Giraffes that had acquired long necks would have offspring with long necks

- ❖ Lamarckian inheritance has been disproved by the discoveries of genetics significance of Lamarckism
- ❖ Was the first comprehensive theory of evolution
- ❖ It nicely explains the existence of vestigial organs

o vestigial organs parts of organism that are no longer in use .this can be used to determine relatedness of species

Ex. front flippers of whale contain bones of limbs that exist in mammals (cow)

Darwinism(theory of natural selection)

Some of Darwin's evidence came from a visit to the Galapagos Islands.

Darwin studied the finches found on the different islands and noted that there were many similarities and differences between them

He concluded that an 'ancestral finch' had colonized the islands and adapt to the different conditions on the islands and, eventually, evolve into different species.

Some of the finches had evolved into insect eaters, with pointed beaks.

Others had evolved into seed eaters with beaks capable of crushing the seeds.

Basic postulates of Darwinism

- ❖ **Geometric increase:-** all species tend to produce more offspring than can possibly survive
- ❖ **Struggle for existence:-** There will be competition between members of a species (because they over-reproduce, and resources are limited).
- ❖ **Variation under nature:-** difference between member of species
- ❖ **Natural selection** and survival of the fittest :

Neo-Darwinism theory

It is the revised version of Darwin's theory

combines Darwin's original theory ,genetic theory and animal behavior

Gene pool of population- the sum of all alleles(genes) available in the population

postulates of neo-Darwinism

- ❖ **Genetic variability**
- ❖ **Natural selection**
- ❖ **Reproductive isolation**

The evidence for evolution

I. comparative anatomy :-is one of the strongest forms of evidence for evolution

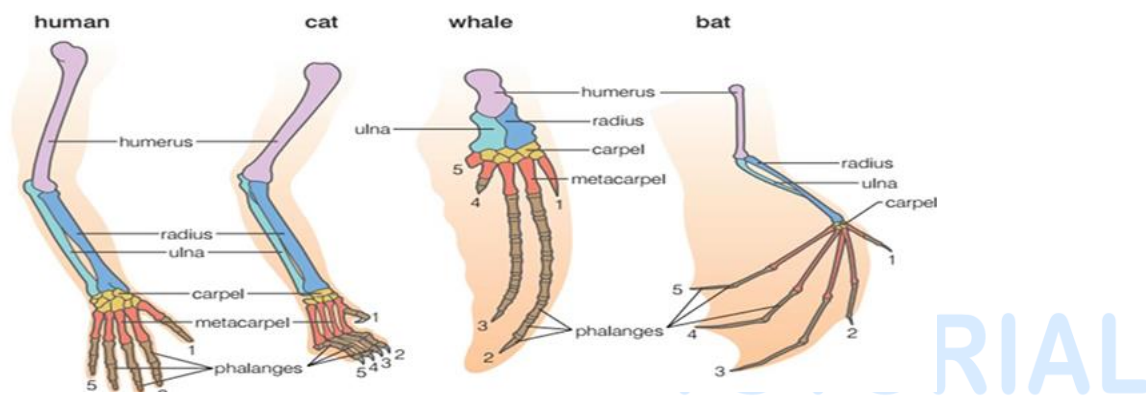
looks at structural similarities of organisms and uses these to determine their possible evolutionary relationships

It assumes that organisms with similar anatomical features are closely related evolutionarily, and that they probably share a common ancestor.

homologous structures :- structures that are very similar in form, but very different in function.

Because they are so similar, they indicate an evolutionary relationship and a common ancestor of the species

o Example - the forelimb of mammals. the forelimbs of humans, whales, cats and bats are all very similar in structure and possesses the same number of bones but different external features and function



Analogous structures:-structures having the same function but different anatomy

• Because they are so different structurally, even though they have the same function, they cannot indicate that two species share a common ancestor

Example -the wings of a bird , butter fly and a mosquito

II. Comparative embryology :-studies the way in which the embryos of vertebrates develop before they hatch or are born

- early in development, all vertebrate embryos have gill slits and tails
- The embryonic tail does not develop into a tail in all species. In humans is reduced to the coccyx(tailbone)
- in many species the 'gill slits' close later in development. However, in fish and larval amphibians they contribute to the development of gills

III. Palaeontology :

- ❖ is the study fossils
- ❖ Fossils are the remains or traces of animals, plants and other organisms from the remote past
 - Formed when certain parts of organisms or plants embedded in the soil or water and preserved for many hundreds of years
- ❖ We can group fossils into two categories:

Category 1: the remains of the dead animal or plant or the imprint left from the remains . can be the actual organism or part of an organism

- bones
- teeth
- skin impressions
- hair
- the hardened shell of an ancient invertebrate such as a trilobite or an ammonite
- an impression of an animal or plant,

Category 2: something that was made by the animal while it was living that has since hardened into stone; these are called trace fossils

- footprints
- burrows
- coprolite (animal faeces)

Dating fossils

sedimentary rocks are laid down in layers (strata)

stratigraphy :- using the sequence of the strata and the fossils that occur in them to deduce how the organisms have changed over time

- ❖ The depth of the strata is related to their age
- ❖ The oldest strata and the oldest fossils, will be in the lowest layers
- ❖ most recent strata and fossils will be nearest to the surface
- ❖ To find out how old each layer is scientists use one of two techniques

1. radiocarbon dating

2. potassium–argon dating

radioactive atoms decay into other atoms over time

- Radioactive carbon atoms (C14) decay into non-radioactive nitrogen atoms (N)
- Radioactive potassium atoms (K40) decay into argon atoms (A40)

half-life - the time needed for half the atoms of a radioactive substance to decay

- ❖ starting with a certain number of radioactive atoms, after one half-life, 50% will still be radioactive
- ❖ After a second half-life, 50% of this 50% will have decayed and 25% of the original number will still be radioactive.
- ❖ After a third half-life 50% of the remaining 25% will have decayed and 12.5% original number will still be radioactive
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IV. Comparative biochemistry

- ❖ Various chemicals have been studied in order to find evidence of evolutionary relationships
- ❖ organisms that share very similar molecules and biochemical pathways are closely related evolutionarily
- ❖ Chemicals that have been used in such analyses include:

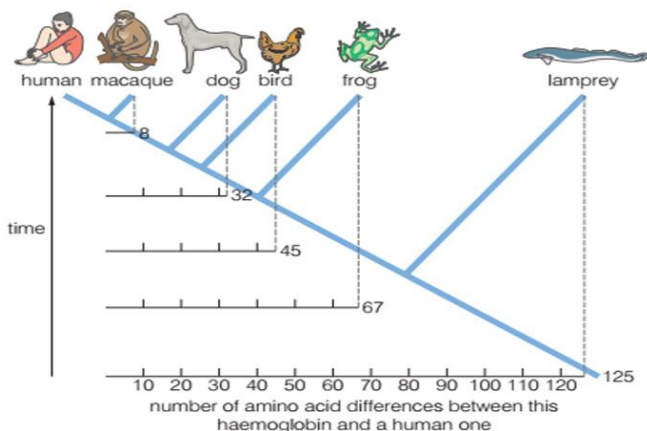
DNA , proteins such as: cytochrome c and haemoglobin

Species that are closely related have the most similar DNA and proteins; those that are distantly related share fewer similarities

example :-98% of our DNA is the same as that of chimpanzees which confirms are closest relatives of humans polypeptide chain

- ❖ The haemoglobin molecule is similar in all animals that possess it, but there are differences

For example, the haemoglobin of the lamprey (a primitive fish-like animal) has only one polypeptide chain



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